3

MANITOBA

Environmental Management Division
Environmental Control Services

Environmental Control Programs

FILE: 2476
DATE: June 12, 1986

Source Testing for Particulate Emissions From the Pathological Incinerator at Selkirk and District General Hospital, Selkirk, Manitoba

1985

Prepared by Kevin E. Reeve, B. Sc.,
Environmental Control Services,
Department of Environment and
Workplace Safety and Health.

TABLE OF CONTENTS

	PAGE
LIST OF FIGURES	ii
LIST OF TABLES	iii
ABSTRACT	iv
INTRODUCTION	1
PROCESS DESCRIPTION	2
PROCESS SCHEDULE	6
TEST PROCEDURES	8
RESULTS	12
DISCUSSION	19
CONCLUSION	20
SELECTED BIBLIOGRAPHY	21
APPENDIX A EQUIPMENT CALIBRATION DATA	22
APPENDIX B VELOCITY PROFILES	26
APPENDIX C FIELD DATA SHEETS	35
APPENDIX D ANALYTICAL REPORT	44

LIST OF FIGURES

		PAGE
FIGURE 1:	PLIBRICO CAB-20-50P INCINERATOR AS INSTALLED AT SELKIRK AND DISTRICT GENERAL HOSPITAL.....	4
FIGURE 2:	STACK CROSS SECTION DEPICTING SAMPLE POINTS.....	10
FIGURE 3:	PARTICULATE STACK SAMPLING TRAIN.....	11

LIST OF TABLES

		PAGE
TABLE 1:	INCINERATOR OPERATIONAL CYCLE.....	5
TABLE 2:	INCINERATOR CHARGING SCHEDULE.....	7
TABLE 3:	SUMMARY OF SAMPLING PARAMETERS.....	13
TABLE 4:	SOURCE EMISSION SUMMARY.....	16

ABSTRACT

During 1985 three source emission surveys were conducted on the incinerator at Selkirk and District General Hospital, Selkirk, Manitoba. After the information and compliance surveys indicated non-compliance with Manitoba Regulation 334/74, Section 3(1), minor changes were made to the incinerator. During a follow-up survey in July and August the incinerator was still in non-compliance with the regulation. At that time the average particulate concentration, when corrected to 12% CO_2, was 1.22 grams per dry standard* cubic metre (g/dscm).

* temperature 20°C, pressure 760 mm Hg

INTRODUCTION

A pathological incinerator is located at Selkirk and District General Hospital to completely destroy pathologicals, expired drugs, small pieces of sharp apparatus and (if wanted) general hospital wastes. During information testing in April 1985 it was noticed that the incinerator cycle timer was either misadjusted or malfunctioning. After this was rectified a compliance survey was conducted. Following modifications to the combustion blower assembly a follow-up compliance survey was completed during July and August 1985.

PROCESS DESCRIPTION

A Plibrico Model CAB-20-50P multiple chamber incinerator was tested for particulate emissions. Figure 1 depicts the incinerator as installed at Selkirk and District General Hospital. The design capacity was 20 cubic feet of Type I waste (normal rubbish) and 50 lbs. of Type IV waste (pathological) per cycle. The pathological, primary and after burner chambers were all heated by natural gas burners with a total heat input capacity of 1,025,000 BTU/hr. The incineration process is automatically controlled by a programmable operation cycle timer, which determines the sequence and duration of firing in the three chambers. The operational cycle for the information tests deviated from the manufacturer's recommendations but were followed for all six compliance tests. See Table 1 for reference examples of the cycles during the testing. Drying, ignition and partial combustion of the waste occurs in the pathological and primary chambers. Air intake to both chambers is reduced to control the combustion rate and temperature. This prevents turbulent gases from transporting ash particles into the after burner chamber. Final combustion of gasified and partially combusted volatile components takes place in the after burner chamber, where air is supplied in excess of stoichiometric requirements to enhance combustion.

Various combustion products exit through a 12.6 m (41.2 ft.) steel stack. A ceramic liner is installed as a heat dissipater. The stack has a continuous inside diameter of 30.5 cm (12 in.).

When the incinerator has cooled, ash is removed from the pathological and primary chambers.

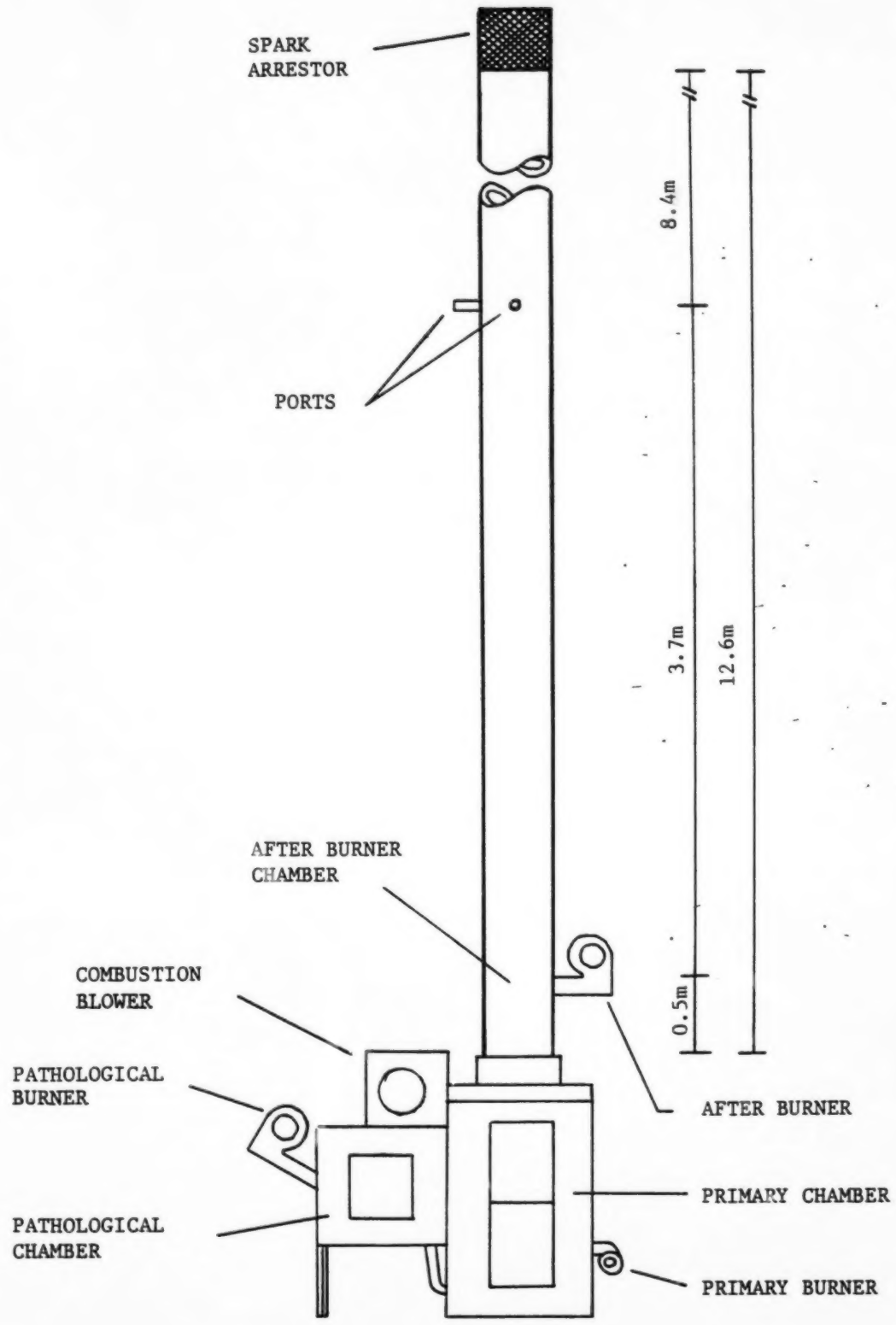


FIGURE 1: PLIBRICO CAB-20-50P INCINERATOR AS INSTALLED AT SELKIRK AND DISTRICT GENERAL HOSPITAL.

TABLE 1: INCINERATOR OPERATIONAL CYCLE

ITEM	INFORMATION TEST 1	INFORMATION TEST 2	COMPLIANCE TEST 1-6
CYCLE INITIATED	8:00 AM*	8:00 AM*	8:00 AM*
AFTER BURNER ON	8:01 AM	8:01 AM	8:01 AM
IGNITION BURNER ON	8:04 AM	8:03 AM	8:31 AM
COMBUSTION BLOWER ON	8:04 AM	8:03 AM	8:31 AM
PATHOLOGICAL BURNER ON	8:05 AM	8:05 AM	8:31 AM
IGNITION BURNER OFF	8:19 AM	8:18 AM	8:46 AM
PATHOLOGICAL BURNER OFF	9:03 AM	9:04 AM	9:31 AM
AFTER BURNER OFF	12:01 PM	12:01 PM	12:01 PM
COMBUSTION BLOWER OFF	4:00 PM	4:00 PM	4:00 PM

* For comparison purposes only all cycles start at 8:00 AM

PROCESS SCHEDULE

Charging material for the 1985 emission tests was limited to 1) general hospital wastes (packaged in green garbage bags), 2) pathological wastes (packaged in red garbage bags) and 3) special wastes such as sharp surgical items, glass ampules and out of date drugs (packaged in sealed cardboard boxes). The charging schedule can be found in Table 2.

TABLE 2: INCINERATOR CHARGING SCHEDULE

TEST NUMBER & DATE	PRIMARY CHAMBER	PATHOLOGICAL CHAMBER
INFORMATION #1 APRIL 23/85	10 bags	8 bags
INFORMATION #2 APRIL 24/85	7 bags	3 bags 14 boxes of sharps
COMPLIANCE #1 APRIL 30/85	8 bags	3 bags
COMPLIANCE #2 MAY 1/85	8 bags	4 bags 3 boxes of drugs
COMPLIANCE #3 MAY 7/85	8 bags	50 lbs.
COMPLIANCE #4 JULY 29/85	8 bags	5 bags 1 box
COMPLIANCE #5 JULY 31/85	10 bags	4 bags 1 box
COMPLIANCE #6 AUGUST 2/85	10 bags	7 bags (1/2 full)

TEST PROCEDURES

All sampling was conducted through two ports located at right angles to each other (south and west) 3.7 m (12.0 ft.) above the after burner and 8.4 m (27.7 ft.) below the top of the stack. This corresponds to 11.1 and 25.4 duct diameters respectively of unrestricted flow before and after the sampling location. Two points were twice sampled along each traverse according to Environmental Protection Service (EPS) Method A specifications. The sample points, located 4.6 and 25.9 cm (1.8 and 10.2 in.) respectively from the inner stack wall are depicted on a cross section of the stack in Figure 2. Sampling intervals were five minutes per point.

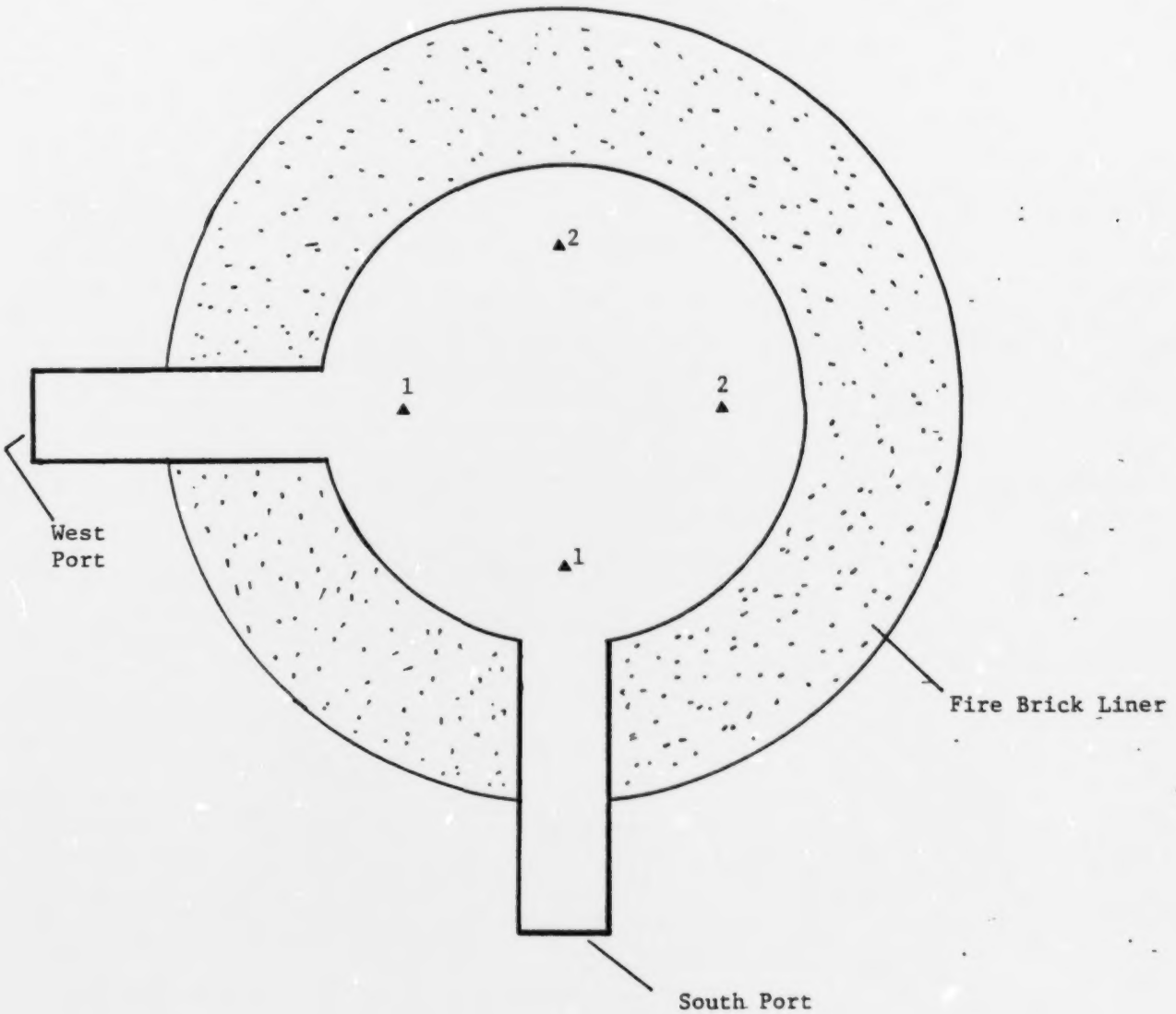
Source emission testing was conducted according to EPS Method E, with one exception. To eliminate metal fatigue caused by the high stack gas temperature, the probe was water cooled rather than electrically heated. Figure 3 illustrates the particulate stack sampling train. The sample was drawn into a 57 mm (0.495 in.) nozzle, through a stainless steel probe and into a miniature cyclone which removed particulate matter of greater than 10μ diameter. The sample was then passed through a Whatman 934 AH glass microfiber filter (supported by a porous fritted glass disc) which removed particulates of 0.3μ diameter and greater. Both the cyclone and the filter were heated to prevent moisture from condensing at that point. The sample was then passed through four 500 ml Greenburg-Smith impingers connected in series in an ice bath. The first, third and fourth

impingers had modified straight tips while the second was of the standard design. The first and second impingers contained 100 ml of deionized water. The third impinger was initially empty while the fourth contained 200 grams of indicating silica gel to remove any remaining moisture from the gas sample.

A Bendix Series 4500 Isokinetic Stack Sampler was used to extract the samples from the stack. Gas velocity in the stack was measured with an S type pitot tube and a Dwyer Magnehelic Differential Pressure Gauge (range 0 to 0.25" H_2O, minor division 0.005" H_2O). Dry gas meter and pitot tube calibration data sheets are located in Appendix A. A Hays-Republic Model 621A Gas Analyzer was used to determine CO_2, O_2 and CO content of the stack gas. Stack temperature was measured by a K type thermocouple.

After sample recovery from the stack train, samples were submitted to the W. M. Ward Technical Services Laboratory for gravimetric analysis of particulates. As the nozzle was not water cooled (and therefore subject to metal fatigue) the particulate matter extracted from it was not included in the sample submitted to the lab.

The sampling team consisted of Kevin Reeve, Art Schultz and Tim Higham.



▲ = Sample Point
Location

FIGURE 2. STACK CROSS SECTION DEPICTING SAMPLE POINTS.

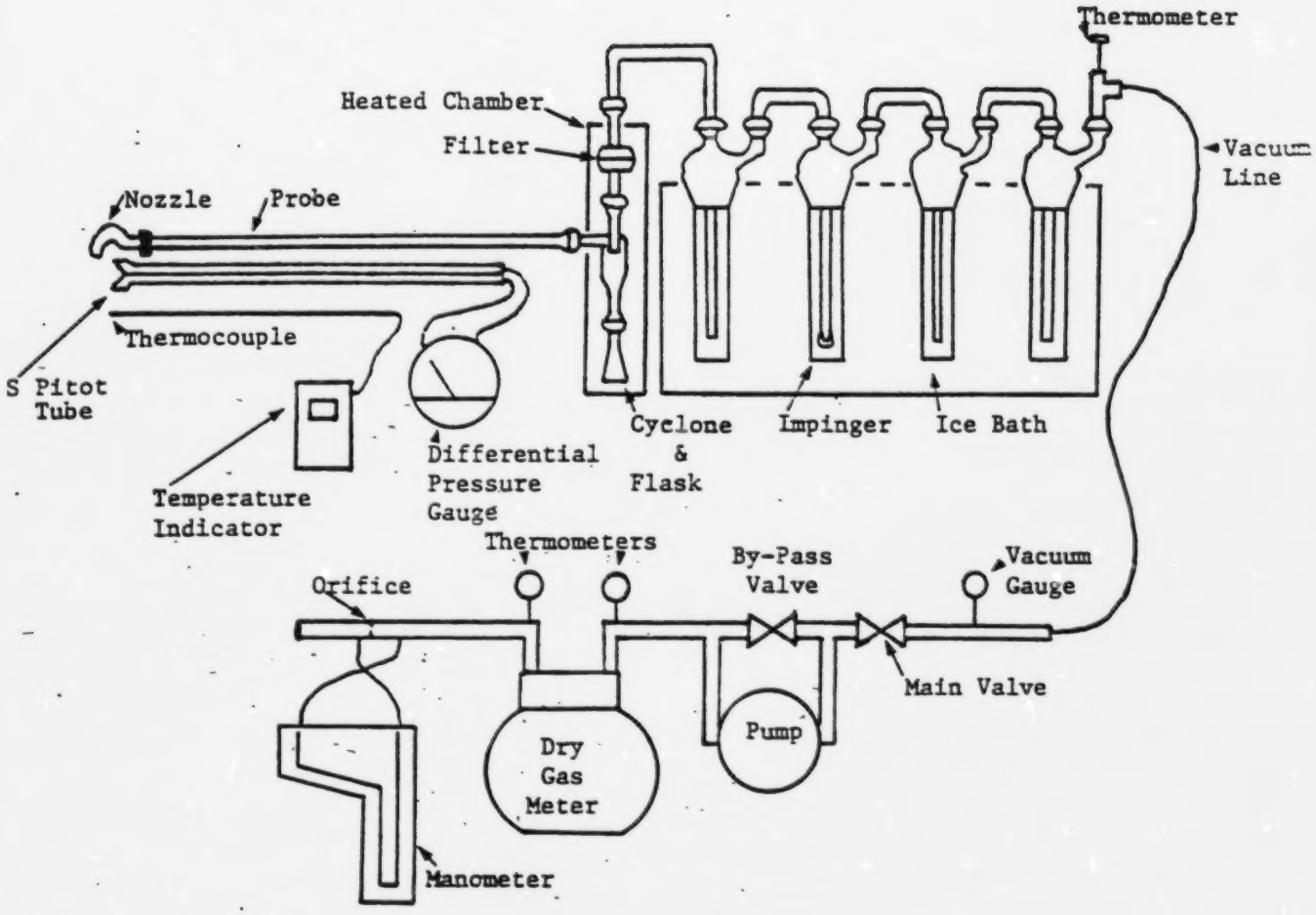


FIGURE 3. Particulate Stack Sampling Train

RESULTS

During the testing program the incinerator was controlled by a programmable operational cycle timer. As noted previously the cycle timer appeared to be malfunctioning and was serviced by the incinerator manufacturer before the compliance testing.

Important sampling parameters are summarized in Table 3. Source emission data are summarized in Table 4. Refer to Appendicies B, C and D respectively for velocity profiles, field data sheets and laboratory analytical reports.

TABLE 3: SUMMARY OF SAMPLING PARAMETERS

TEST NUMBER	INFORMATION 1	INFORMATION 2
SAMPLING DATE	April 23/85	April 24/85
SAMPLING DURATION, min.	40	40
SAMPLING VOLUME AT METER CONDITIONS, m^3	0.7256	0.8833
SAMPLING VOLUME AT STANDARD CONDITIONS, dscm*	0.6739	0.8280
AVERAGE GAS METER TEMPERATURE, °C	32	30
ORIFICE PRESSURE DROP, mm H_2O	32.8	53.7
STACK STATIC PRESSURE, mm H_2O	+7.37	+7.37
AVERAGE STACK GAS TEMPERATURE, °C	712	823
AVERAGE STACK GAS VELOCITY, m/s	7.9	11.7
ISOKINETIC FACTOR, %	107.1	107.3

*Standard Conditions are 20°C and 760 mm Hg

TABLE 3: (CONTINUED)

TEST NUMBER	COMPLIANCE 1	COMPLIANCE 2	COMPLIANCE 3
SAMPLING DATE	April 30/85	May 1/85	May 7/85
SAMPLING DURATION, min.	40	40	40
SAMPLING VOLUME AT METER CONDITIONS, m^3	0.7630	0.9028	0.7144
SAMPLING VOLUME AT STANDARD CONDITIONS, dscm*	0.7311	0.8592	0.6682
AVERAGE GAS METER TEMPERATURE, °C	27	29	33
ORIFICE PRESSURE DROP, mm H_2O	41.1	55.4	34.9
STACK STATIC PRESSURE, mm H_2O	+7.37	+7.37	+7.37
AVERAGE STACK GAS TEMPERATURE, °C	932	1007	976
AVERAGE STACK GAS VELOCITY, m/s	11.5	14.4	11.1
ISOKINETIC FACTOR, %	108.2	105.5	102.5

*Standard Conditions are 20°C and 760 mm Hg

TABLE 3: (CONTINUED)

TEST NUMBER	COMPLIANCE 4	COMPLIANCE 5	COMPLIANCE 6
SAMPLING DATE	July 29/85	July 31/85	August 2/85
SAMPLING DURATION, min.	40	40	40
SAMPLING VOLUME AT METER CONDITIONS, m^3	0.8167	0.8501	0.8722
SAMPLING VOLUME AT STANDARD CONDITIONS, dscm*	0.7565	0.7701	0.7968
AVERAGE GAS METER TEMPERATURE, °C	36	42	37
ORIFICE PRESSURE DROP, mm H_2O	44.2	47.5	49.8
STACK STATIC PRESSURE, mm H_2O	+7.37	+7.37	+7.37
AVERAGE STACK GAS TEMPERATURE, °C	813	782	785
AVERAGE STACK GAS VELOCITY, m/s	11.0	10.9	11.2
ISOKINETIC FACTOR, % 106.6	99.3	99.4	100.8

*Standard Conditions are 20°C and 760 mm Hg

TABLE 4: SOURCE EMISSION SUMMARY

TEST NUMBER		INFORMATION 1	INFORMATION 2	AVERAGE
STACK GAS COMPOSITION DRY BASIS, % BY VOLUME	CO_2	9.5	8.6	-
	O_2	4.0	11.0	-
	CO	0.4	0.0	-
STACK GAS MOISTURE, % BY VOLUME		7.3	14.0	-
Ms**, g/g-mole		28.83	28.17	-
AVERAGE STACK GAS VOLUMETRIC FLOW RATE, dscm/h		556	686	621
CONCENTRATION OF PARTICULATE IN THE STACK GAS, g/dscm:	AT STACK	0.01	1.11	0.56
	AT 12% CO_2	0.02	1.56	0.79
EMISSION RATE OF PARTICULATE, kg/h		0.01	0.76	0.39

** Molecular Weight of the Stack Gas on a Wet Basis

TABLE 4: (CONTINUED)

TEST NUMBER		COMPLIANCE 1	COMPLIANCE 2	COMPLIANCE 3	AVERAGE
STACK GAS COMPOSITION DRY BASIS, % BY VOLUME	CO_2	14.0	9.5	11.2	-
	O_2	1.0	6.0	3.0	-
	CO	0.8	0.4	0.0	-
STACK GAS MOISTURE, % BY VOLUME		15.4	15.4	15.3	-
Ms**, g/g-mole		28.39	28.00	28.09	-
AVERAGE STACK GAS VOLUMETRIC FLOW RATE, dscm/h		605	720	570	632
CONCENTRATION OF PARTICULATE IN THE STACK GAS, g/dscm:	AT STACK CO_2	0.95	1.30	0.57	0.94
	AT 12% CO_2	0.81	1.64	0.61	1.02
EMISSION RATE OF PARTICULATE, kg/h		0.57	0.94	0.33	0.61

** Molecular Weight of the Stack Gas on a Wet Basis

TABLE 4: (CONTINUED)

TEST NUMBER		COMPLIANCE 4	COMPLIANCE 5	COMPLIANCE 6	AVERAGE
STACK GAS COMPOSITION DRY BASIS, % BY VOLUME	CO_2	5.2	5.4	6.6	-
	O_2	15.2	13.4	11.9	-
	CO	0.0	0.0	0.0	-
STACK GAS MOISTURE, % BY VOLUME		12.6	12.0	12.6	-
Ms**, g/g-mole		28.00	28.03	28.08	-
AVERAGE STACK GAS VOLUMETRIC FLOW RATE, dscm/h		671	684	697	684
CONCENTRATION OF PARTICULATE IN THE STACK GAS, g/dscm:	AT STACK CO_2	0.43	0.51	0.86	0.60
	AT 12% CO_2	0.99	1.12	1.56	1.22
EMISSION RATE OF PARTICULATE, kg/h		0.29	0.35	0.60	0.41

** Molecular Weight of the Stack Gas on a Wet Basis

DISCUSSION

Both a malfunctioning operational cycle timer and improper loading procedures may be responsible for excessive particulate emission.

The low particulate emission figures for information test 1 indicate that the sample was extracted after the ignition burner had shut off - consequently most of the charge had already been incinerated. During the last three tests too much excess air appears to have entered the incinerator, entraining ash particles which are then released to the atmosphere and also reducing the percentage of CO_2 in the stack gas. As the particulate concentration is corrected to 12% CO_2 in the stack gas it is very important to limit the amount of excess air entering the incinerator.

CONCLUSION

Compliance tests indicate an average particulate emission of 1.02 g/dscm when corrected to 12% CO_2 (0.94 g/dscm at average stack CO_2 values) for tests 1 to 3, and 1.22 g/dscm at 12% CO_2 (0.60 g/dscm at average stack CO_2 values) for tests 4 to 6. Both sets of tests indicate non compliance with the Manitoba Regulation 334/74, Section 3(1) limit of 0.23 g/dscm of flue gas corrected to 12% CO_2.

SELECTED BIBLIOGRAPHY

1. Reeve, Kevin E. Source Testing For Particulate Emissions From The Incinerator At Cara Operations Ltd., Winnipeg, Manitoba. Wpg., Mb: Manitoba Department of Environment and Workplace Safety and Health, 1983.

2. Standard Reference Methods For Source Testing: Measurement Of Emission Of Particulates From Stationary Sources. Ottawa, Ont: Environment Canada, Environmental Protection Service, 1974 (Report EPS 1-AP-74-1).

APPENDIX A: EQUIPMENT CALIBRATION DATA

DRY GAS METER & ORIFICE METER CALIBRATION SHEET

Lab No. 5338 1/2

Dry Gas Meter S/N Rockwell 711030

Calibrated re Large Wet Test Meter

Atmospheric Pressure 29.27 in Hg or 743.5 mm Hg

Calibrated by Jim Yurkanovich & Kevin Reeve

Ambient Temperature 23.6 °C

Date 15 Mar. 95

Manometer Orifice ΔH (in. H_2O)	W.T.M. Volume Vw ($Ft.^3$)	Dry Gas Meter Reading Initial ($Ft.^3$)	Dry Gas Meter Reading Final ($Ft.^3$)	D.G.M. Volume Vd ($Ft.^3$)	Temperature W.T.M. Tw (°F.)	Temperature W.T.M. Tw (°C.)	Temperature D.G.M. Ti (°F.)	Temperature D.G.M. To (°F.)	Time t (Min.&Sec.)	Time t (Min.)	W.T.M. Manometer Δm (in. H_2O)	Partial Pressure Pa (mm. Hg)	W.T.M./D.G.M. Ratio γ (—)	$\sqrt{\quad}$ (—)	Flowra @ S.C. Qm ($Ft.^3/m$
3.02	6.0	610.283	616.396	6.113	72.6	22.6	120	85	6:22.57	6.3762	0.74	20.565	0.9985	1.3884	0.9275
3.02	6.0	618.431	624.569	6.133	72.6	22.6	122	87	6:23.21	6.3869	0.74	20.565	0.9988	1.3910	0.9294
3.02	6.0	626.615	632.772	6.157	72.6	22.6	123	87	6:23.23	6.3872	0.64	20.565	0.9960	1.3910	0.9295
2.55	6.0	635.815	642.025	6.210	72.5	22.5	123	88	6:55.48	6.9247	0.68	20.441	0.9878	1.2801	0.8602
2.55	6.0	644.088	650.277	6.189	72.5	22.5	123	89	6:55.98	6.9330	0.70	20.441	0.9940	1.2813	0.8607
2.55	6.0	151.315	157.512	6.197	72.5	22.5	124	90	6:56.09	6.9348	0.72	20.441	0.9944	1.2824	0.8624
2.04	5.0	157.584	164.758	5.174	72.5	22.5	124	90	6:27.28	6.4547	0.64	20.441	0.9940	1.1478	0.7727
2.04	5.0	615.781	670.965	5.179	72.5	22.5	124	90	6:27.57	6.4595	0.52	20.441	0.9933	1.1473	0.7725
2.04	5.0	672.003	677.182	5.179	72.5	22.5	124	90	6:27.86	6.4643	0.58	20.441	0.9932	1.1478	0.7719
1.53	5.0	679.257	683.445	5.188	72.5	22.5	124	90	7:26.74	7.4457	0.61	20.441	0.9927	0.9946	0.6709
1.53	5.0	686.519	691.710	5.191	72.5	22.5	124	90	7:27.07	7.4512	0.54	20.441	0.9923	0.9946	0.6705
1.53	5.0	692.752	697.942	5.190	72.6	22.6	124	90	7:26.91	7.4485	0.59	20.565	0.9920	0.9946	0.6705

Linear Regression: Intercept (b) 0.0020

Slope (K) 0.6695

Coefficient of Determination (r^2) 0.9998

$\overline{\gamma}$ = 0.9931 ± 0.0026

ΔH@ = 2.0505

Comments:

#245 Rev. 9/3/93 JF/cm

DRY GAS METER & ORIFICE METER CALIBRATION SHEET

Lab No. 5338 2/2

Dry Gas Meter S/N Roots 711030

Calibrated re Large Wet Test Meter

Atmospheric Pressure 27.27 in Hg or 74

Calibrated by Jim Peterson & Kevin Reese

Ambient Temperature 23.1°C

Date 15 Nov 85

Manometer Orifice ΔH (in. H_2O)	W.T.M. Volume Vw ($Ft.^3$)	Dry Gas Meter Reading Initial ($Ft.^3$)	Dry Gas Meter Reading Final ($Ft.^3$)	D.G.M. Volume Vd ($Ft.^3$)	Temperature W.T.M. Tw (°F.)	Temperature W.T.M. Tw (°C.)	Temperature D.G.M. Ti (°F.)	Temperature D.G.M. To (°F.)	Time t (Min.:Sec.)	Time t (Min.)	W.T.M. Manometer Δ n (in. H_2O)	Partial Pressure Ps (mm. Hg)	W.T.M.:D.G.M. Ratio γ (—)	$\sqrt{\quad}$ (—)	Flowra S.T. Qm ($Ft.^3$/m
1.03	4.0	700.019	704.178	4.159	72.6	22.6	123	90	7:17.84	7.2973	0.52	20.565	0.9908	0.8166	0.5483
1.03	4.0	704.304	708.463	4.159	72.6	22.6	123	90	7:18.19	7.3032	0.46	20.565	0.9910	0.8166	0.5479
1.03	4.0	709.377	713.538	4.159	72.6	22.6	123	90	7:18.31	7.3052	0.46	20.565	0.9910	0.8166	0.5471
0.512	3.0	715.105	718.218	3.113	72.7	22.6	119	90	7:47.56	7.7927	0.33	20.565	0.9909	0.5711	0.3857
~~0.509~~	~~3.0~~	~~718.713~~	~~721.848~~	~~3.135~~	~~72.8~~	~~22.7~~	~~119~~	~~90~~	~~7:48.08~~	~~7.8013~~	~~0.33~~	~~20.670~~	~~0.9926~~	~~0.5744~~	~~0.3851~~
0.511	3.0	721.378	725.493	3.105	72.9	22.7	119	90	7:48.39	7.8065	0.36	20.670	0.9928	0.5755	0.3848
0.505	3.0	727.045	730.156	3.111	73.0	22.8	119	90	7:49.78	7.8130	0.34	20.815	0.9906	0.5722	0.3843

Linear Regression: Intercept (b) 0.0020

Slope (K) 0.6695

Coefficient of Determination (r^2) 0.9998

$\bar{\gamma}$ = 0.9931 ± 0.0026

$\Delta H@$ = 2.0505

Comments:

#245 Rev. 9/25/83 JF/cm

S-TYPE PITOT TUBE CALIBRATION

PROBE SIZE (ft) 5' SS Water Cooled CALIBRATION # 85 - 25

PROBE LINER SS DATE April 12, 1985

PROBE MANUFACTURER BENDIX

TIP SIZE (inches) 0.500

STACK THERMOCOUPLE ☒ PRESENT

☐ ABSENT

HP 97 INPUT/OUTPUT

Temp	21.3	°C
Bar. Press	29.36	In. Hg
Scale Factor	0.1	

1	0.10	Δ p (std)
Tunnel Velocity	6.727909	ft/sec
	0.17	Δ p (s-pitot)
Cp, at this	0.765048	velocity
Tunnel Velocity	6.729319	(using Cp)

2	0.22	Δ p (std)
	9.979101	
	0.36	Δ p (s-pitot)
	0.779782	
	9.981192	

3	0.29	Δ p (std)
	11.457215	
	0.48	Δ p (s-pitot)
	0.775338	
	11.459617	

4	0.39	Δ p (std)
	13.286555	
	0.65	Δ p (s-pitot)
	0.772660	
	13.289339	

5	0.51	Δ p (std)
	15.193757	
	0.83	Δ p (s-pitot)
	0.781914	
	15.196941	

6	0.69	Δ p (std)
	17.672770	
	1.11	Δ p (s-pitot)
	0.786459	
	17.676474	

7	0.84	Δ p (std)
	19.499332	
	1.35	Δ p (s-pitot)
	0.786839	
	19.503418	

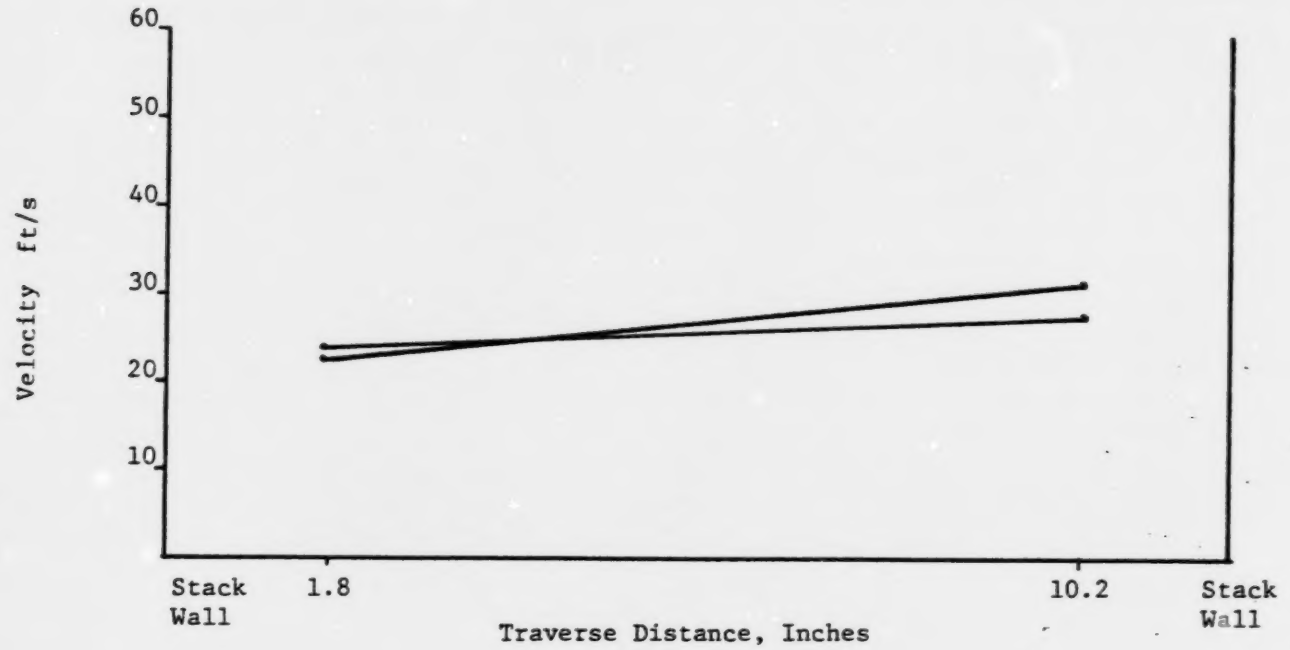
8	1.24	Δ p (std)
	23.691411	
	1.96	Δp(s-pitot)
	0.793406	
	23.696376	

9	1.72	Δ p (std)
	27.902576	
	2.67	Δp(s-pitot)
	0.800611	
	27.908424	

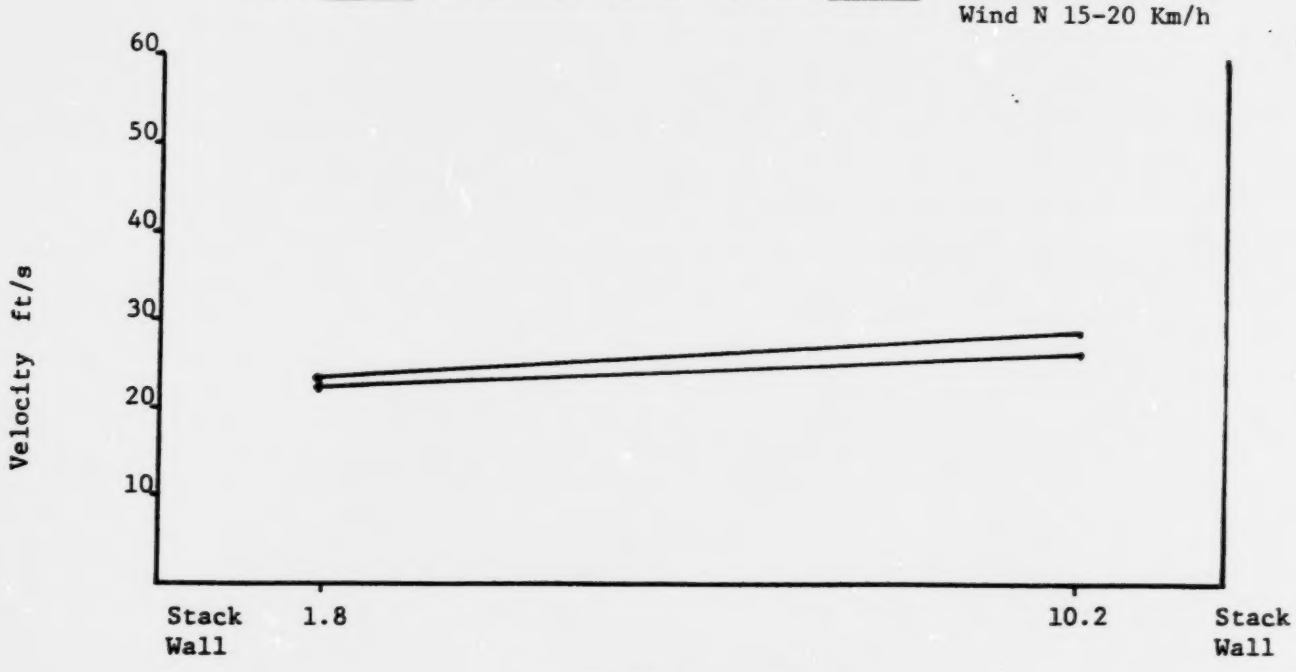
0.782451	Cp (ave)
0.010850	Std. Dev.
8	Deg. of Freedom
2.306	t .05
0.774110	Low Cp
0.782451	Mean Cp
0.790791	High Cp

APPENDIX B: VELOCITY PROFILES

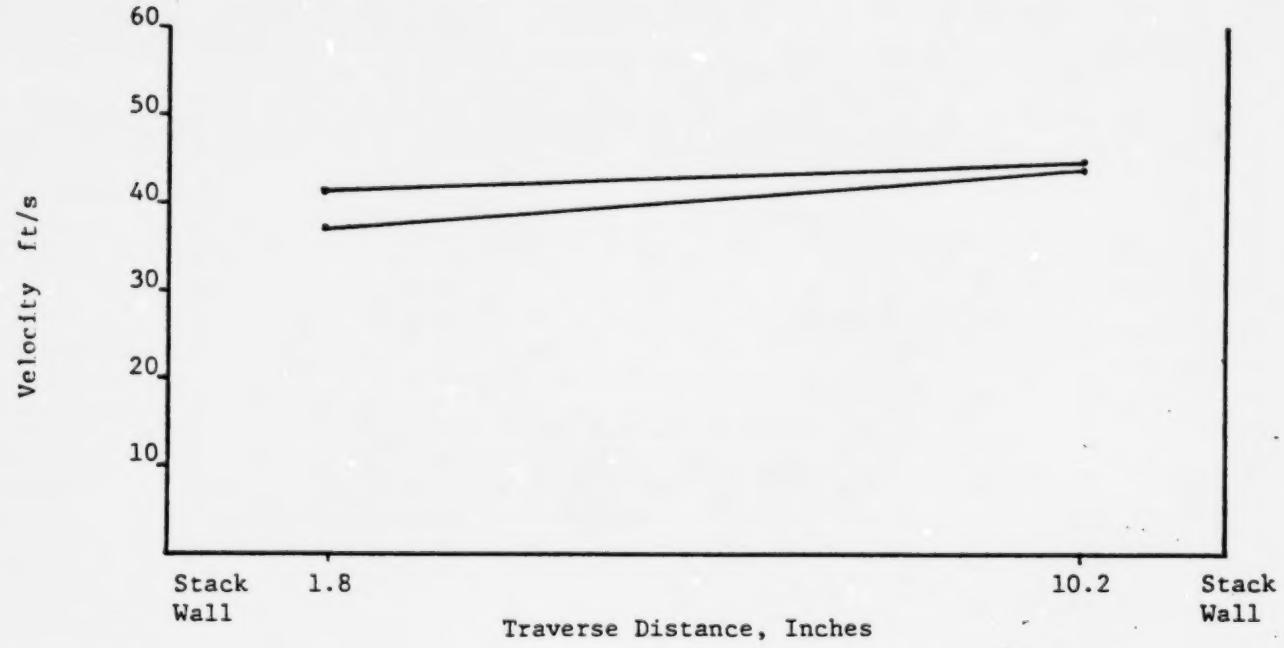
Graph 1 . Velocity Profile of Test INFO 1 . South Port
Wind N 15-20 Km/h



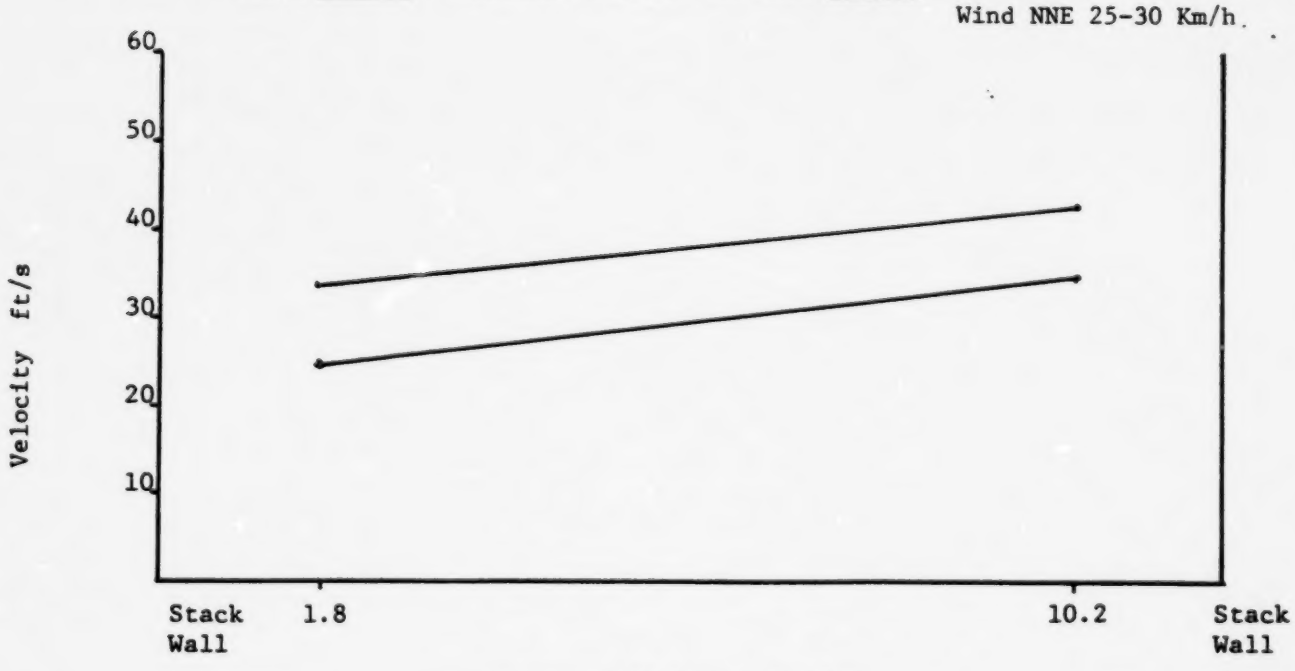
Graph 2 . Velocity Profile of Test INFO 1. West Port
Wind N 15-20 Km/h



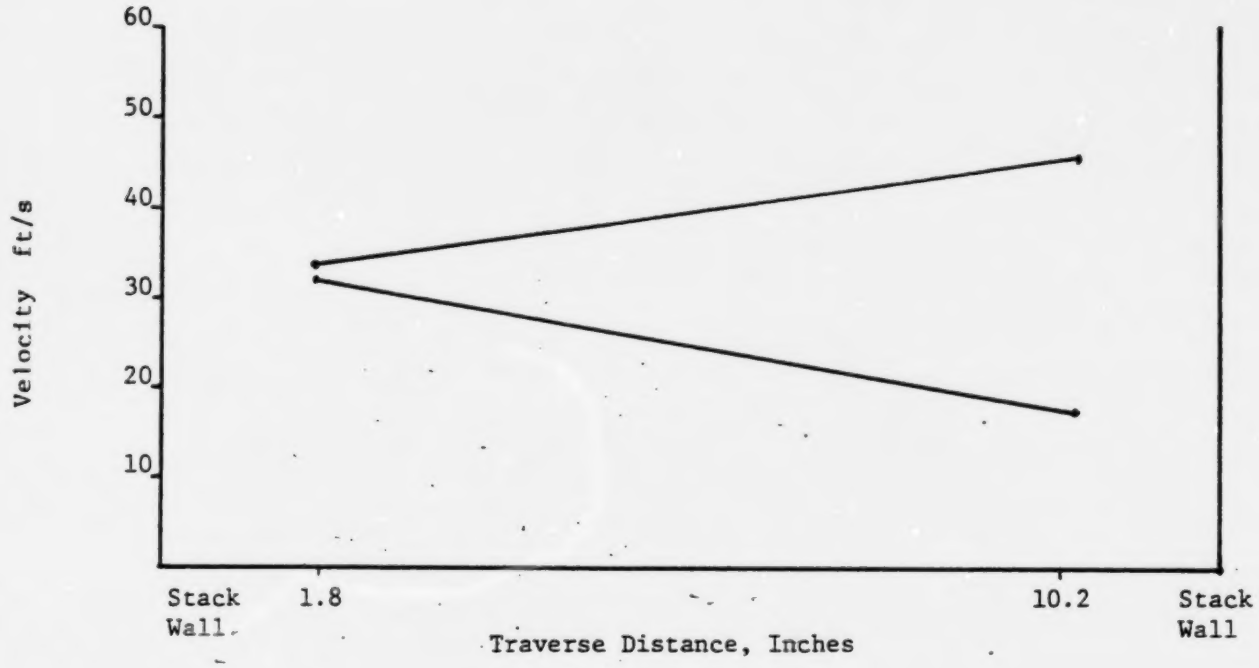
Graph 3 . Velocity Profile of Test INFO 2 . South Port
Wind NNE 25-30 Km/h



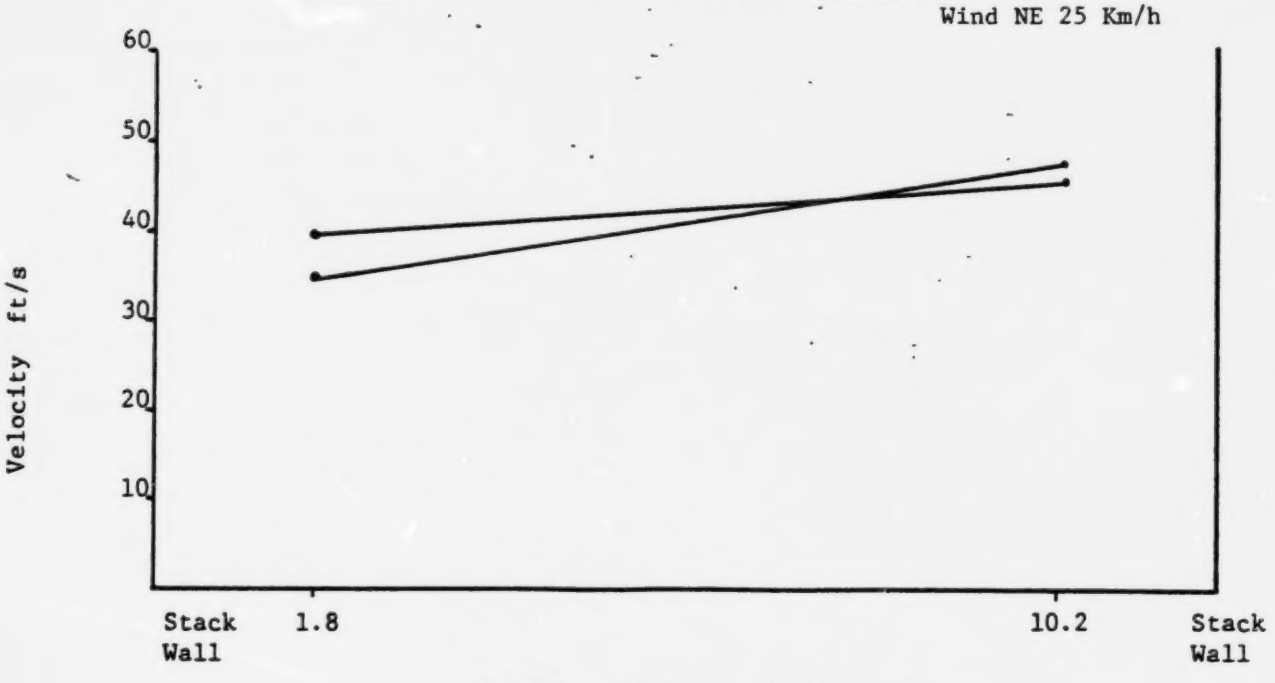
Graph 4 . Velocity Profile of Test INFO 2. West Port
Wind NNE 25-30 Km/h



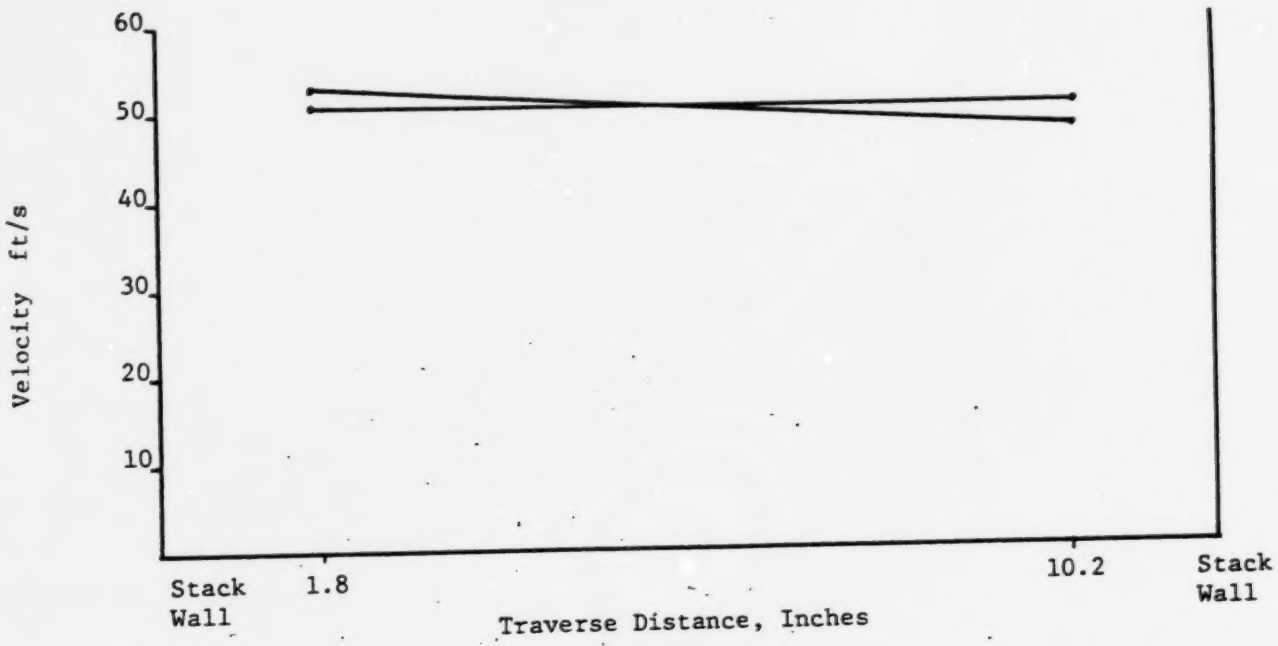
Graph 5. Velocity Profile of Test 1. South Port
Wind NE 25 Km/h



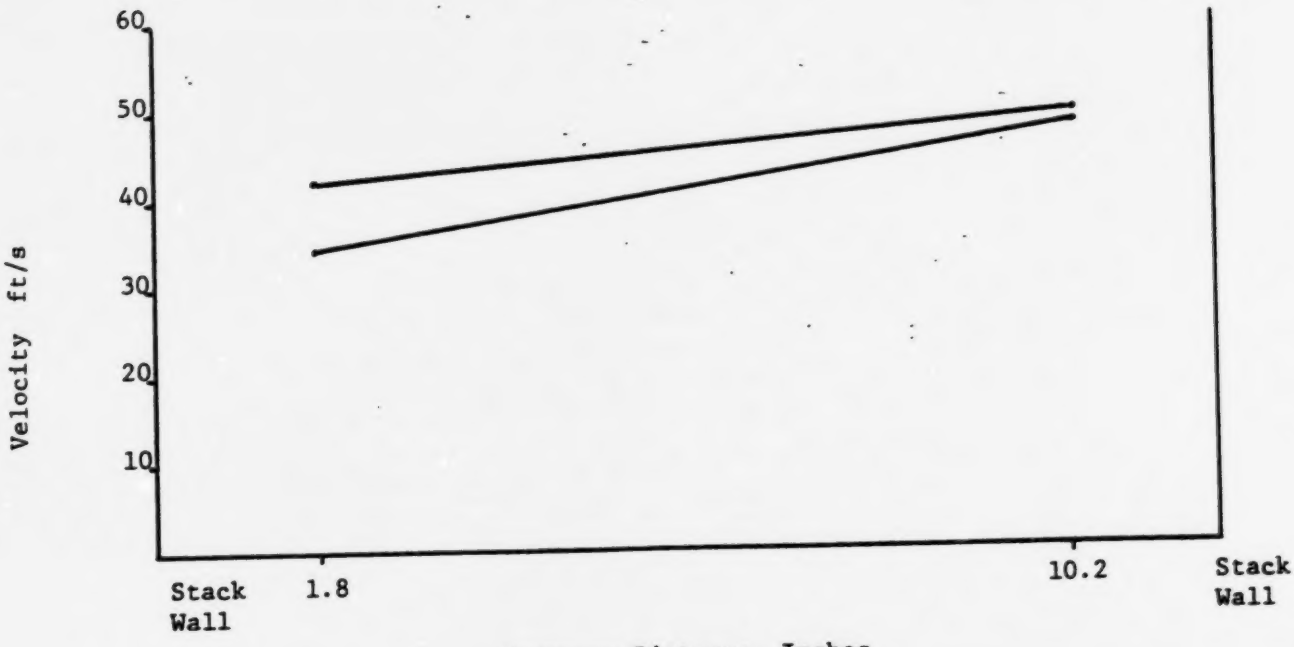
Graph 6. Velocity Profile of Test 1. West Port
Wind NE 25 Km/h



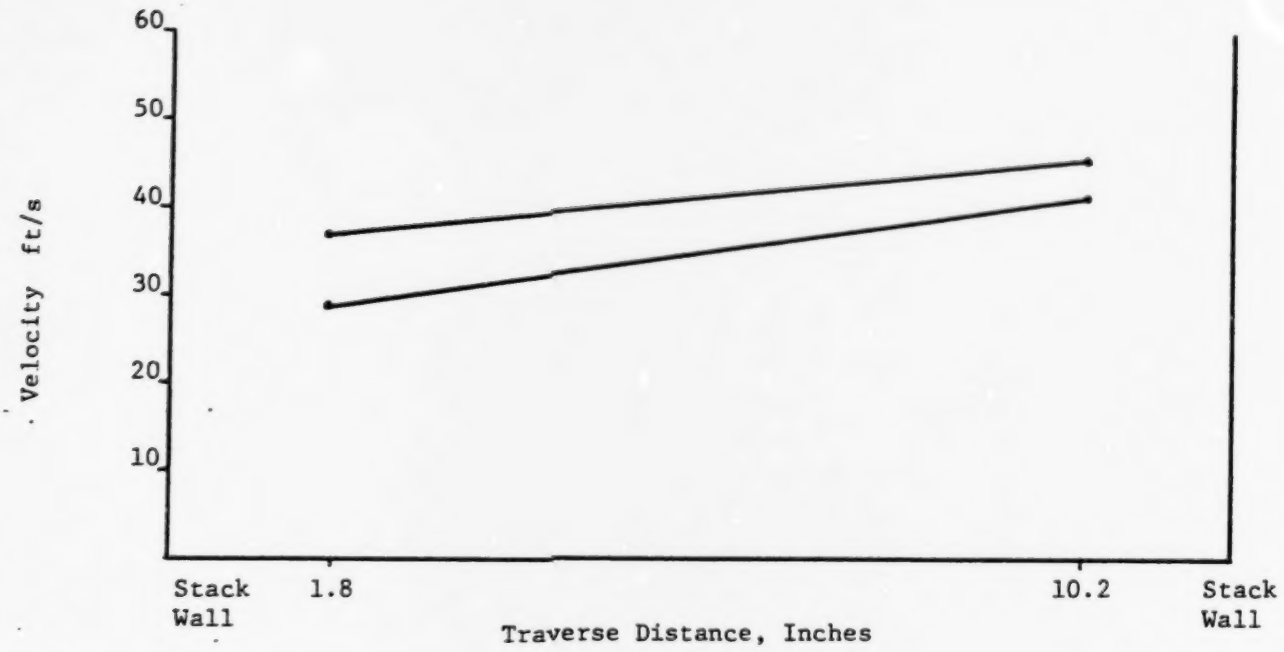
Graph 7. Velocity Profile of Test 2. South Port
Wind SE 25-35 Km/h



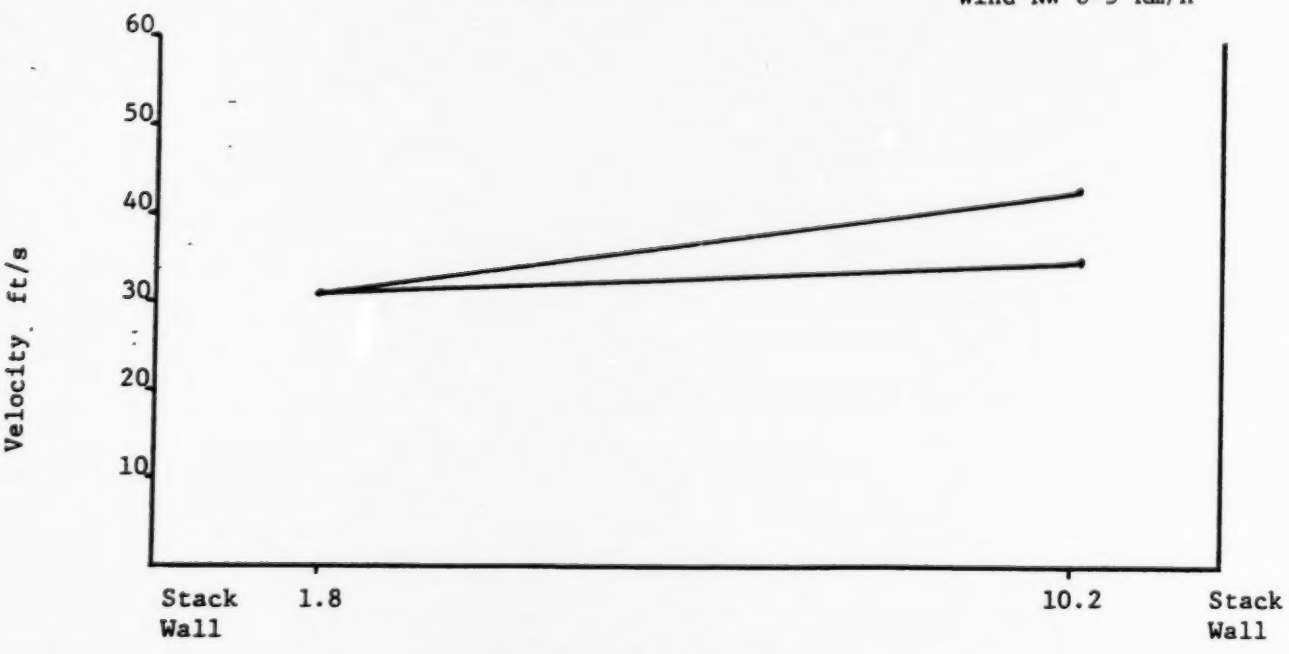
Graph 8. Velocity Profile of Test 2. West Port
Wind SE 25-35 Km/h



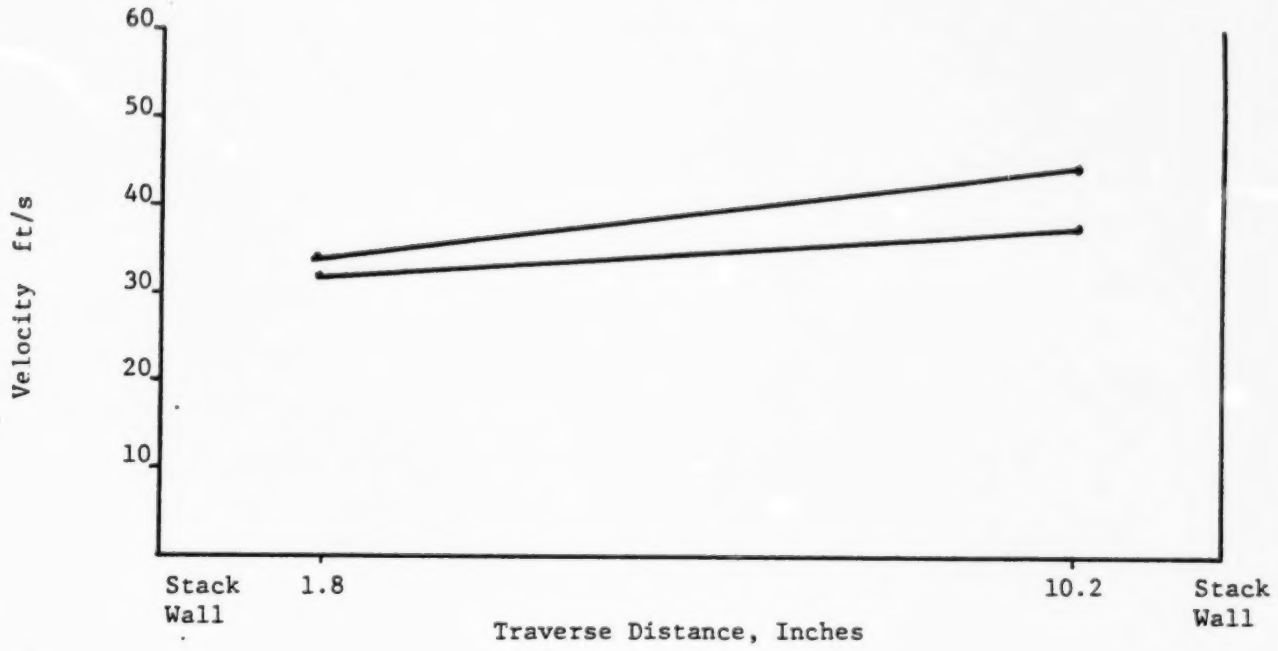
Graph 9 . Velocity Profile of Test 3 . South Port
Wind NW 0-5 Km/h



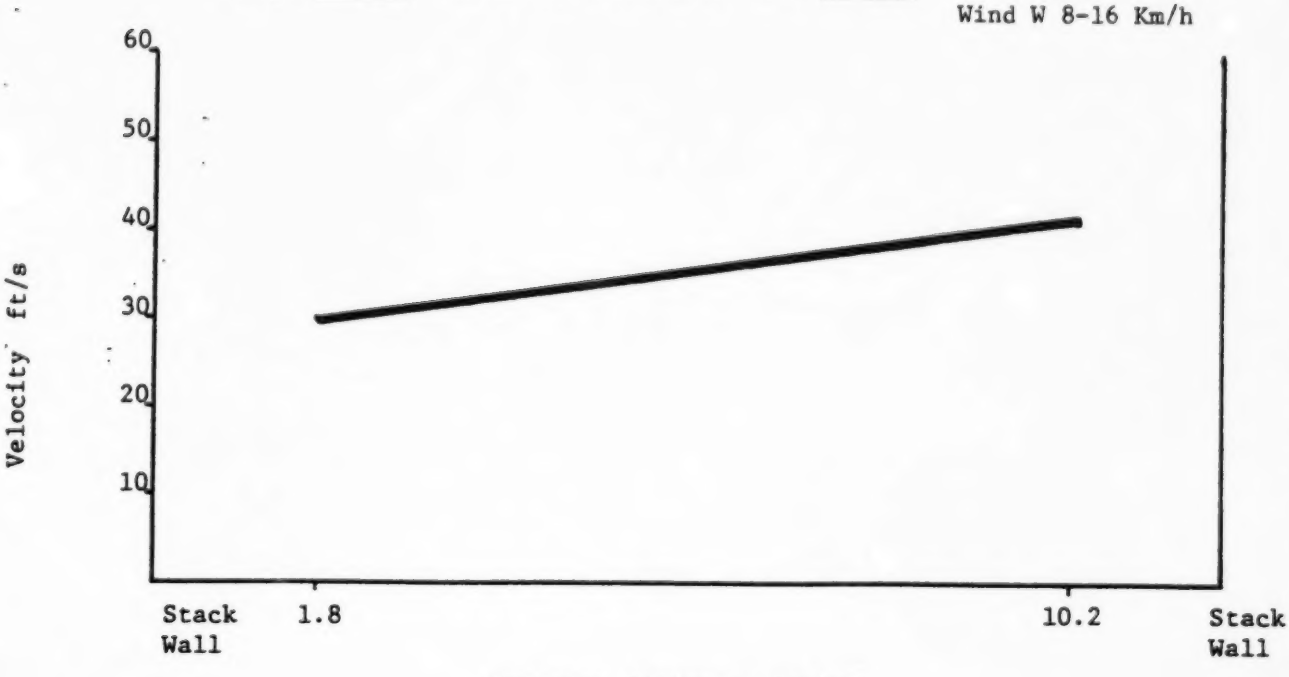
Graph 10 . Velocity Profile of Test 3 . West Port
Wind NW 0-5 Km/h



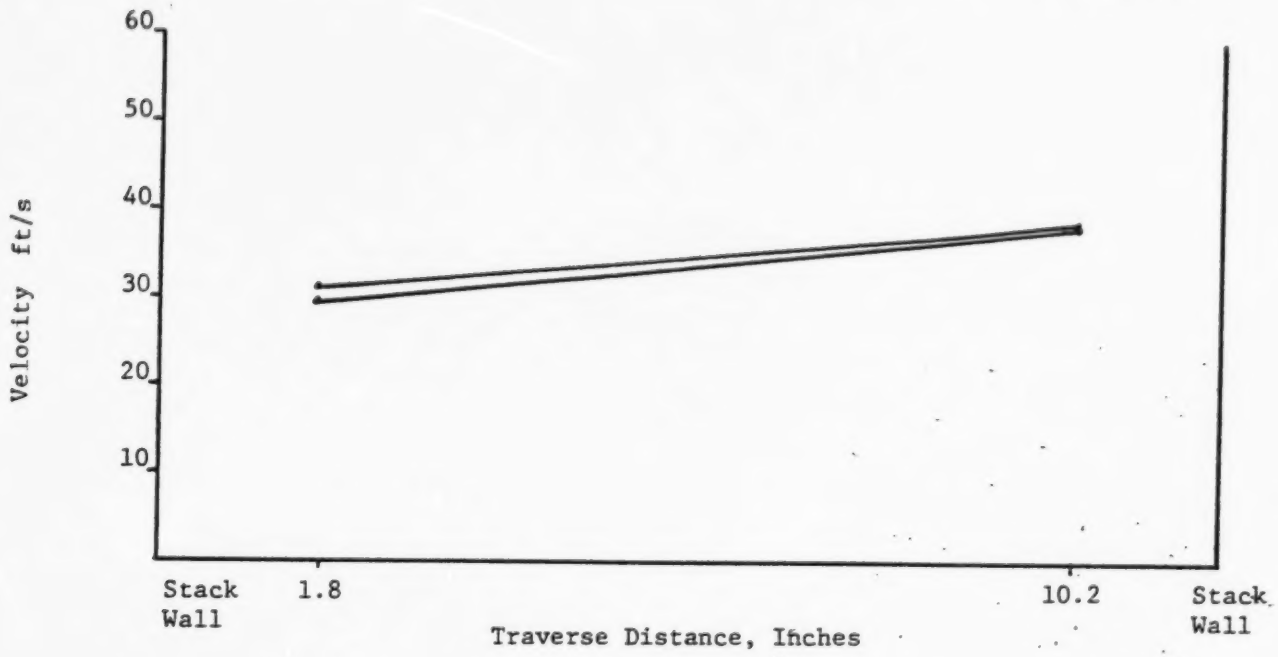
Graph 11. Velocity Profile of Test 4. South Port
Wind W 8-16 Km/h



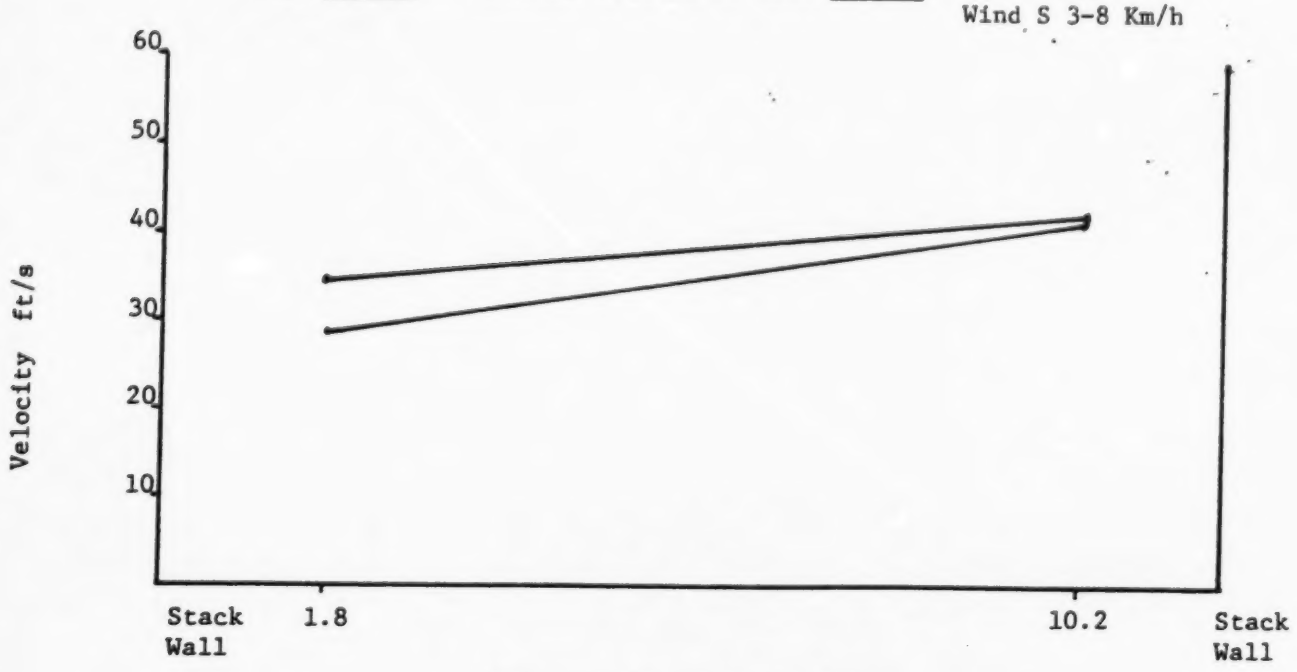
Graph 12. Velocity Profile of Test 4. West Port
Wind W 8-16 Km/h



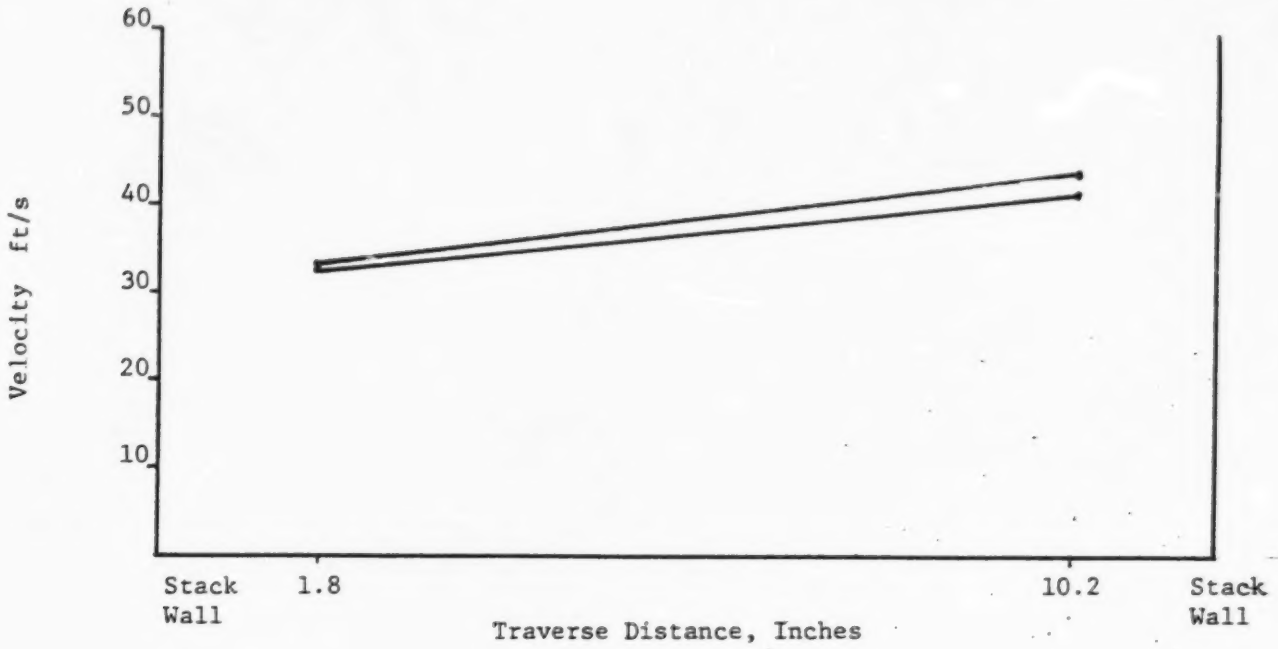
Graph 13 . Velocity Profile of Test 5 . South Port
Wind S 3-8 Km/h



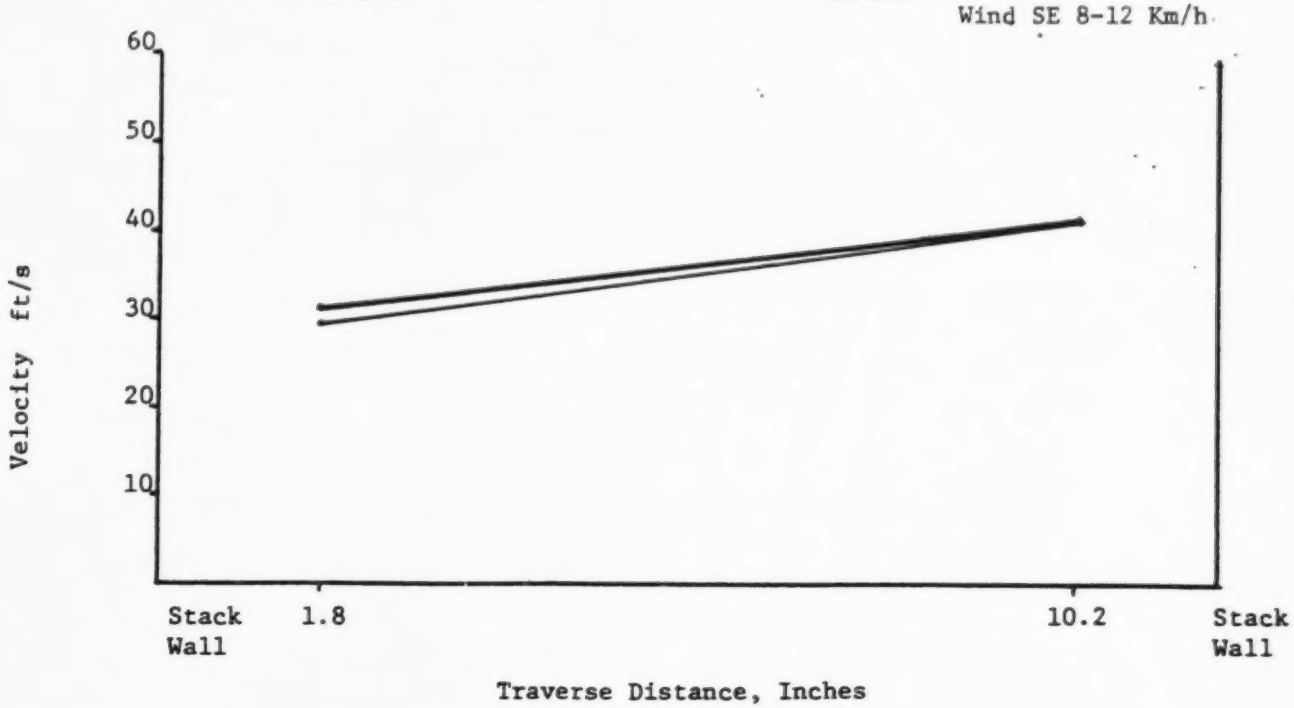
Graph 14 . Velocity Profile of Test 5 . West Port
Wind S 3-8 Km/h



Graph 15 . Velocity Profile of Test 6 . South Port
Wind SE 8-12 Km/h



Graph 16 . Velocity Profile of Test 6 . West Port
Wind SE 8-12 Km/h



APPENDIX C: FIELD DATA SHEETS

FIELD DATA SHEET

Plant SELKIRK AND DISTRICT GENERAL HOSPITAL Location 100 GENERAL HOSPITAL DRIVE, SELKIRK, MANITOBA

Stack PATHOLOGICAL INCINERATOR Test number INFORMATION 1 Date APRIL 23, 1985

Ambient temperature (°F) 65 Barometric pressure (in. Hg) 29.06 Time 12:50 P.M. to 1:36 P.M.

Nozzle diameter (in.) 0.495 Probe length/type 5 FOOT/WATER COOLED Stack static pressure (in. H_2O) + 0.29

Probe temperature (°F) ave 272 Filter holder temperature (°F) ave 211 Leak check 0.008 CFM @ 18" Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. H_2O	Isokinetic factor, %
						Inlet	Outlet			
S - 1	0	1289	3.045	0.063	1.143	82	82	54	4	108.0
2	5	1391	3.304	0.080	1.385	84	82	59	5	107.2
2	10	1390	3.825	0.110	1.889	98	81	69	6	104.9
1	15	1343	2.837	0.055	0.972	100	82	65	6	107.9
W - 1	20	1231	2.968	0.056	1.051	94	82	69	4	109.3
1	25	1243	2.913	0.056	1.059	99	82	73	4	107.1
2	30	1291	3.260	0.071	1.304	102	83	75	5	107.6
2	35	1326	3.469	0.086	1.538	105	84	77	5	104.6
Average or total	40	1313	25.621	0.072	1.293	-	-	-	-	107.1

FIELD DATA SHEET

Plant SELKIRK AND DISTRICT GENERAL HOSPITAL Location 100 GENERAL HOSPITAL DRIVE, SELKIRK, MANITOBA

Stack PATHOLOGICAL INCINERATOR

INFORMATION

Ambient temperature (°F) 60 Barometric pressure (in. Hg) 29.06 Test number 2 Date APRIL 24, 1985

Nozzle diameter (in.) 0.495 Probe length/type 5 FOOT/WATER COOLED Time 10:28 A.M. to 11:25 A.M.

Probe temperature (°F) ave 146 Filter holder temperature (°F) ave 246 Stack static pressure (in. H_2O) + 0.29

Leak check 0.008 CFM @ 18 " Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. H_2O	Isokinetic factor, %
						Inlet	Outlet			
S - 1	0	1644	4.018	0.150	2.192	80	79	51	8	109.5
2	5	1666	4.245	0.180	2.499	95	77	53	11	105.1
2	10	1650	4.430	0.180	2.548	98	78	66	13	110.4
1	15	1596	3.733	0.130	1.798	99	79	75	8	108.2
W - 1	20	1300	2.697	0.060	0.927	85	82	54	5	105.0
2	25	1342	4.280	0.150	3.093	90	80	56	15	106.3
2	30	1499	4.300	0.170	2.405	106	80	59	14	103.6
1	35	1579	3.488	0.100	1.453	108	82	61	7	111.3
Average or total	40	1535	31.191	0.140	2.113	-	-	-	-	94.1

FIELD DATA SHEET

Plant SELKIRK AND DISTRICT GENERAL HOSPITAL Location 100 GENERAL HOSPITAL DRIVE, SELKIRK, MANITOBA

Stack PATHOLOGICAL INCINERATOR Test number Compliance 1 Date APRIL 30, 1985

Ambient temperature (°F) 56 Barometric pressure (in. Hg) 29.43 Time 10:37 A.M. to 11:30 A.M.

Nozzle diameter (in.) 0.495 Probe length/type 5 FOOT/WATER COOLED Stack static pressure (in. H_2O) + 0.29

Probe temperature (°F) ave 211 Filter holder temperature (°F) ave 247 Leak check 0.010 CFM @ 18 " Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. H_2O	Isokinetic factor, %
						Inlet	Outlet			
W - 1	0	1775	3.674	0.135	1.770	74	69	48	5	113.1
2	5	1925	3.948	0.180	2.240	88	69	52	8	107.5
2	10	1987	3.904	0.185	2.140	92	70	66	8	105.7
1	15	1889	3.060	0.100	1.210	96	71	68	6	110.4
S - 1	20	1580	3.067	0.095	1.230	94	74	62	5	105.1
2	25	1766	1.564	0.025	0.324	90	74	60	3	109.3
2	30	1719	4.162	0.185	2.430	100	74	58	8	105.1
1	35	1489	3.562	0.110	1.610	106	75	59	7	109.0
Average or total	40	1766	26.941	0.127	1.619	-	-	-	-	108.2

FIELD DATA SHEET

Plant SELKIRK AND DISTRICT GENERAL HOSPITAL Location 100 GENERAL HOSPITAL DRIVE, SELKIRK, MANITOBA

Stack PATHOLOGICAL INCINERATOR Test number Compliance 2 Date MAY 1, 1985

Ambient temperature (°F) 56 Barometric pressure (in. Hg) 29.37 Time 10:48 A.M. to 11:36 A.M.

Nozzle diameter (in.) 0.495 Probe length/type 5 FOOT/WATER COOLED Stack static pressure (in. H_2O) +0.29

Probe temperature (°F) ave 153 Filter holder temperature (°F) ave 262 Leak check 0.010 CFM @ 15" Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. H_2O	Isokinetic factor, %
						Inlet	Outlet			
S - 1	0	1875	4.220	0.205	2.528	80	74	50	10	106.2
2	5	1863	4.192	0.205	2.442	91	74	51	11	104.0
2	10	1895	4.315	0.220	2.555	97	74	56	13	103.5
1	15	1900	4.013	0.180	2.135	99	74	62	11	106.2
W - 1	20	1837	3.532	0.145	1.771	90	78	55	8	103.2
2	25	1847	4.095	0.195	2.379	100	78	55	12	102.6
2	30	1804	4.210	0.190	2.365	100	79	59	13	105.7
1	35	1732	3.301	0.100	1.279	98	80	60	9	112.2
Average or total	40	1844	31.878	0.180	2.182	-	-	-	-	105.5

FIELD DATA SHEET

Plant SELKIRK AND DISTRICT GENERAL HOSPITAL Location 100 GENERAL HOSPITAL DRIVE, SELKIRK, MANITOBA

Stack PATHOLOGICAL INCINERATOR Test number Compliance 3 Date MAY 7, 1985

Ambient temperature (°F) 69 Barometric pressure (in. Hg) 29.33 Time 10:34 A.M. to 11:29 A.M.

Nozzle diameter (in.) 0.495 Probe length/type 5 FOOT/WATER COOLED Stack static pressure (in. H_2O) + 0.29

Probe temperature (°F) ave 260 Filter holder temperature (°F) ave 249 Leak check 0.014 CFM @ 17 " Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. H_2O	Isokinetic factor, %
						Inlet	Outlet			
W - 1	0	1881	2.524	0.075	0.849	82	78	46	4	104.0
2	5	1930	3.411	0.140	1.604	94	78	46	6	103.1
2	10	1953	2.824	0.090	0.996	106	78	52	6	105.4
1	15	1875	2.428	0.075	0.859	106	78	54	6	97.6
S - 1	20	1620	2.707	0.075	0.975	94	87	54	5	103.2
2	25	1678	3.735	0.150	1.949	110	85	55	6	101.0
2	30	1709	4.130	0.180	2.252	115	86	62	7	102.2
1	35	1660	3.468	0.120	1.509	117	87	63	7	103.4
Average or total	40	1788	25.227	0.113	1.374	-	-	-	-	102.5

FIELD DATA SHEET

Plant SELKIRK AND DISTRICT GENERAL HOSPITAL Location 100 GENERAL HOSPITAL DRIVE, SELKIRK, MANITOBA

Stack PATHOLOGICAL INCINERATOR Test number Compliance 4 Date JULY 29, 1985

Ambient temperature (°F) 73 Barometric pressure (in. Hg) 29.38 Time 10:37 A.M. to 11:25 A.M.

Nozzle diameter (in.) 0.495 Probe length/type 5 FOOT/WATER COOLED Stack static pressure (in. H_2O) + 0.29

Probe temperature (°F) ave 134 Filter holder temperature (°F) ave 270 Leak check 0.001 CFM @ 15" Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. H_2O	Isokinetic factor, %
						Inlet	Outlet			
S - 1	0	1676	3.121	0.100	1.300	94	87	55	5	100.7
2	5	1688	3.921	0.170	2.120	103	87	56	9	96.7
2	10	1585	3.649	0.130	1.720	107	87	63	7	100.2
1	15	1430	3.334	0.100	1.450	108	88	67	6	99.9
W - 1	20	1334	3.187	0.090	1.370	100	91	57	6	98.4
2	25	1444	4.115	0.160	2.324	110	91	59	10	97.6
2	30	1448	4.215	0.160	2.291	112	92	64	10	99.8
1	35	1353	3.298	0.090	1.364	114	92	69	7	101.2
Average or total	40	1495	28.840	0.125	1.742	-	-	-	-	99.3

FIELD DATA SHEET

Plant SELKIRK AND DISTRICT GENERAL HOSPITAL Location 100 GENERAL HOSPITAL DRIVE, SELKIRK, MANITOBA

Stack PATHOLOGICAL INCINERATOR Test number Compliance 5 Date JULY 31, 1985

Ambient temperature (°F) 81 Barometric pressure (in. Hg) 29.35 Time 10:33 A.M. to 11:20 A.M.

Nozzle diameter (in.) 0.495 Probe length/type 5 FOOT/WATER COOLED Stack static pressure (in. H_2O) + 0.29

Probe temperature (°F) ave 142 Filter holder temperature (°F) ave 262 Leak check 0.001 CFM @ 15" Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. H_2O	Isokinetic factor, %
						Inlet	Outlet			
S - 1	0	1480	3.066	0.085	1.240	104	98	64	5	99.4
2	5	1461	3.910	0.140	2.060	112	96	62	8	98.0
2	10	1432	4.099	0.145	2.160	115	96	71	8	100.0
1	15	1367	3.446	0.100	1.550	118	96	84	6	98.9
W - 1	20	1471	3.633	0.115	1.740	115	102	60	7	99.8
2	25	1513	4.190	0.165	2.383	122	102	60	9	96.8
2	30	1465	4.320	0.165	2.445	123	102	61	9	99.7
1	35	1329	3.352	0.085	1.365	124	102	64	7	102.3
Average or total	40	1440	30.016	0.125	1.868	-	-	-	-	99.4

FIELD DATA SHEET

Plant SELKIRK AND DISTRICT GENERAL HOSPITAL Location 100 GENERAL HOSPITAL DRIVE, SELKIRK, MANITOBA

Stack PATHOLOGICAL INCINERATOR Test number Compliance 6 Date AUGUST 6, 1985

Ambient temperature (°F) 72 Barometric pressure (in. Hg) 29.18 Time 10:32 A.M. to 11:19 A.M.

Nozzle diameter (in.) 0.495 Probe length/type 5 FOOT/WATER COOLED Stack static pressure (in. H_2O) + 0.29

Probe temperature (°F) ave 123 Filter holder temperature (°F) ave 270 Leak check 0.001 CFM @ 15" Hg Vacuum

Traverse point number	Clock time, start	Stack gas temperature, °F	Gas meter volume, cu. ft.	Velocity pressure, in. H_2O	Orifice pressure drop in. H_2O	Gas meter temperature, °F		Final impinger Temperature, °F	Pump vacuum in. H_2O	Isokinetic factor, %
						Inlet	Outlet			
S - 1	0	1506	3.327	0.100	1.440	97	88	60	5	102.2
2	5	1561	4.065	0.160	2.250	105	88	56	6	99.7
2	10	1634	4.210	0.170	2.300	110	89	60	6	101.3
1	15	1399	3.573	0.110	1.670	113	90	65	5	100.3
W - 1	20	1314	3.467	0.100	1.586	106	93	61	5	99.8
2	25	1425	4.290	0.165	2.492	114	93	61	7	98.8
2	30	1426	4.400	0.165	2.487	117	94	65	7	101.2
1	35	1297	3.466	0.090	1.458	120	95	69	5	103.4
Average or total	40	1445	30.798	0.133	1.960	-	-	-	-	100.8

APPENDIX D: ANALYTICAL REPORT

R.M. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

SUBMITTER: KEVIN REEVE
LOCATION: SELKIRK GEN. HOSPITAL (SEE BELOW)
REPORT TO: KEVIN REEVE
ER-1

SAMPLE – ID: From Y 85 Sequent 7948 To Y 85 Sequent 7950

Date Sampled: Y 85 M 9 D 23
Date Received: Y 85 M 9 D 25

L – Less than
G – Greater than

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analysed
7948	BOTTLE #1 - Probe washings & Glassware	TSP		0.0816	g	85D14,3P
7949	BOTTLE #2 - Impinger 1 and 2 Contents	TSP		0.0027	g	85D14,3P
7950	FILTER #478	TSP		0.0003	g	85D14,3P

Date: 85 09 13

Chemist Signature:

WM. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

SUBMITTER: KEVIN REEVE
LOCATION: SELKIRK GEN. HOSPITAL (SEE BELOW)
REPORT TO: KEVIN REEVE
ER-1

SAMPLE – ID
From: Y 85 Sequent 07A51
To: Y 85 Sequent 07953

L – Less than
G – Greater than

Date Sampled: Y 85 M 09 D 24
Date Received: Y 85 M 09 D 25

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analysed
7951	BOTTLE #1	TSP		0.7926	g	85 10 30
	- Probe washings					
	and Glassware					
7952	BOTTLE #2	TSP		0.0118	g	85 10 30
	- Impinger Lead					
	2 contents					
7953	FILTER # 429	TSP		0.1283	g	85 10 30

Chemist Signature _____ Date _____

RM. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

LEGAL

SUBMITTER: K. REEVE
LOCATION: SELKIRK GEN. HOSPITAL TEST # 1
REPORT TO: K. REEVE
EE-1

SAMPLE – ID
From: Y 85 Sequent 10649
To: Y 85 Sequent 10651

L – Less than
G – Greater than

Date Sampled: Y 85 M 10 D 30
Date Received: Y 85 M 05 D 02

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analysed
10649	BOTTLE #1	TSP		0.5795	g	85 05 08
10650	BOTTLE #2	TSP		0.0143	g	85 05 08
10651	FILTER - #430	TSP		0.1114	g	85 05 08

Chemist Signature _____ Date _____

R.M. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

LEGAL

SUBMITTER: K. REEVE
LOCATION: SELKIRK GEN. HOSPITAL TEST #2
REPORT TO: K. REEVE
ER-1

SAMPLE – ID From: Year 85, Sequent 10652 To: Year 85, Sequent 10654

L – Less than
G – Greater than

Date Sampled: 85 05 01 Date Received: 85 05 02

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analyzed
10652	BOTTLE # 1	TSP		0.0985	g	85 05 08
10653	BOTTLE # 2	TSP		0.0286	g	85 05 08
10654	FILTER # 431	TSP		0.1314	g	85 05 08

Chemist Signature

Date 85 05 23

R.M. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

LEGAL

SUBMITTER: K. REEVE
LOCATION: SELKIRK GEN HOSPITAL TEST #3
REPORT TO: K. REEVE
ER-1

From SAMPLE – ID: Y 85 Sequent 1,1,908
To: Y 85 Sequent 1,1,910

L – Less than
G – Greater than

Date Sampled: Y 85 M 05 D 07
Date Received: Y 85 M 05 D 08

Sample Number	Identification o. Comments	Parameter	L/G	Value	Units	Date Analyzed
11908	BOTTLE # 1	TSP		0,3311,5	g	85 05 08
11909	BOTTLE # 2	TSP		0,0115	g	85 05 08
11910	FILTER # 432	TSP		0,0518	g	85 05 08

Chemist Signature _____ Date 85-05-15

WM. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

SUBMITTER: KEVIN REEVE
LOCATION: SELKIRK GENERAL HOSPITAL (TEST #4)
REPORT TO: KEVIN REEVE
ER-1

SAMPLE – ID
From: Y 85, Sequent 19592
To: Y 85, Sequent 19594

L – Less than
G – Greater than

Date Sampled: Y 85, M 7, D 29
Date Received: Y 85, M 8, D 01

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analysed
19592	BOTTLE #1	TSP		0.2562	g	85/8/6
	- Probe washings					
	and Glassware					
	before Filter					
19593	BOTTLE #2	TSP		0.0129	g	85/8/6
	- Impinger 1					
	and 2 Contents					
19594	FILTER #453	TSP		0.0406	g	85/8/6

Chemist Signature _____ Date _____

WM. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

SUBMITTER: KEVIN REEVE
LOCATION: SELKIRK GENERAL HOSPITAL (TSP'S)
REPORT TO: KEVIN REEVE
ER-1

SAMPLE – ID From: Y 85 Sequent 19,595 To: Y 85 Sequent 19,597

L – Less than
G – Greater than

Date Sampled: Y 85 M 07 D 31
Date Received: Y 85 M 08 D 01

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analyzed
19595	BOTTLE #1	TSP		0.3516.1	g	85.09.17
	- Probe washings and Glassware before Filter.					
19596	BOTTLE #2	TSP		0.0131.1	g	85.09.17
	- Impinger 1 and 2 contents					
19597	FILTER # 452	TSP		0.0327.7	g	85.09.13

SEE ER-1 [illegible]

Chemist Signature _____ Date _____

IMG 2622(ss) 87/02 SM

R.M. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II LEGAL

SUBMITTER: KEVIN REEVE
LOCATION: SELKIRK GENERAL HOSPITAL (TEST #6)
REPORT TO: KEVIN REEVE
ER-4

SAMPLE – ID From: Y 85 Sequent 21293 To: Y 85 Sequent 21295

L – Less than
G – Greater than

Date Sampled: Y 85 M 08 D 12
Date Received: Y 85 M 08 D 23

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analysed
21293	BOTTLE # 1: - Filter washings and Glassware before Filter.	TSP		01.6.5.5.2.	g	85.09.05
21294	BOTTLE # 2: - Impinger 1 and 2 contents	TSP		01.6.1.0.8.	g	85.09.12.5
21295	FILTER # 454	TSP		01.6.2.8.6.	g	85.09.12.5

SEP 25 1985

Chemist Signature _____ Date _____